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ABSTRACT

Discussed is the use of the herbicide 2,4-D. Though written for farmers and agricultural workers, the pamphlet considers turf weed control and use of 2,4-D near ornamental plants. Aspects of the use of this herbicide covered are: (1) the common forms of 2,4-D; (2) plant responses and tolerances to the herbicide; (3) dilution and concentration of the chemical; and (4) spraying. Much of the information on spraying 2,4-D involves use on crops and problem weeds like Canada thistle and field bindleweed. Other parts discuss spraying 2,4-D on turf, along fence rows and ditch banks, and for control of aquatic weeds. Some general information on sprayers and application techniques is given. In general, the infcrmation in this bulletin is non-technical and introductory in nature. (ME)

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Extension Bulletin 389

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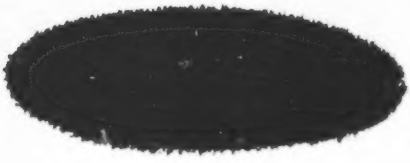
KILLING WEEDS with



SE 024 318

PURDUE UNIVERSITY
Agricultural Extension Service
Lafayette, Indiana

Killing Weeds with 2,4-D

BY OLIVER C. LEE,
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SPRAYING WITH 2,4-D (2,4-dichlorophenoxyacetic acid) is a common and recognized weed control. It may be done to destroy susceptible weeds in both crop or non-crop areas. Certain crops are sufficiently tolerant of 2,4-D so that it can be used in them as a selective herbicide. 2,4-D can be used to control broad-leaved weeds in such crops as corn, wheat, oats, barley, rye and sorghums. Since grasses are quite tolerant of 2,4-D, it can be used to control weeds in grass crops. Spraying to control broad-leaved weeds in lawns, parks, golf courses and other turf areas is a common practice. 2,4-D is also used to control certain woody plants along ditches, on rights-of-way when land is cleared of woody growth, and for emergent aquatic weeds in ponds and lakes.

2,4-D is an Organic Chemical

2,4-D is sometimes referred to as a growth regulating substance, but when applied in sufficient quantity, it kills most plants. There are two liquid formulations of 2,4-D on the market: (1) *Amine salts* and (2) *esters*. There are many forms of esters. The most recent and safest to use are designated as low volatile esters. Most 2,4-D liquids on the market contain four pounds of 2,4-D acid or acid equivalent per gallon. More recently 2,4-D in granular form has become available. Generally its use has been limited to control of water weeds and susceptible species of woody plants.

SUGGESTION: Before purchasing 2,4-D, read the label on the container to determine the type and concentration of the material. Both the amine and low volatile esters are used to kill weeds. The esters are often thought to be more effective than the amines, especially when used on plants that are difficult to kill. The esters are recommended when 2,4-D is used as a pre-emergence type treatment.

Plants Respond Slowly to 2,4-D

After a susceptible weed is sprayed, the material is absorbed by the stems and leaves and is translocated throughout all plant parts. It interferes with normal plant growth and finally causes a complete breakdown of the plant tissue. The first symptoms of the effect of 2,4-D are twisting and curling of plant parts, which usually takes place some 24 hours after spraying. Plants may stay green for several days before they die. The time will vary with different species of plants, dosages applied, and such factors as temperature and moisture, which effect normal plant growth.

The first symptom of effect of 2,4-D is twisting of the stems and branches as shown here of a horseweed or giant ragweed plant.

Weeds Vary in Tolerance in 2,4-D

Grassy weeds and some broad-leaved weeds such as nightshade and milkweed are difficult to kill with 2,4-D. They are usually considered tolerant of 2,4-D. Some broad-leaved weeds are more easily killed by 2,4-D than others. Therefore, the amount of 2,4-D needed to produce results will vary with the different weeds. The amount needed will also vary with the stage of growth at the time of application. Young weeds usually are killed more easily than more mature plants.

The following list of common Indiana weeds and amounts of 2,4-D to use per acre may be used as a guide when spraying. Rates are given in liquid measures indicating the amount to use per acre when products containing 4 pounds of 2,4-D per gallon are used. The lighter rates should be used when plants are young and the heavier rates indicated are to be used when plants are near maturity. Those indicated as resistant are not normally killed by 2,4-D.

CAUTION: When spraying to kill weeds in crops the crop tolerance should be considered. (See Pages 6-8 *"Spraying in Crops."*)

Suggested amounts of 2,4-D per acre needed to kill weeds are listed. The lower rates are used when plants are young, the higher rate when plants are more mature. When spraying in growing crops check tolerance of crop.

Weeds	Amount of 2,4-D per acre
Artichoke (wild)	1-1 ½ quarts
Aster (fall)	1-1 ½ quarts
Barnyardgrass	Resistant
Bedstraw (cleavers)	1-1 ½ quarts
Beggarstick	½-1 quart
Bermudagrass	Resistant
Bindweed (field)	1-1 ½ quarts
Bitter winter cress—yellow rocket	1-1 ½ quarts
Bladder champion	¾-1 quart
Bouncing bet	Resistant
Broom sedge	Resistant
Buckhorn plantain	½-1quart
Buckwheat (wild)	Resistant
Buffalo bur	Resistant
Bull thistle—pasture thistle	¾-1 quart
Burdock	½-1 quart
Buttercup (wild)	1-1 ½ quart
Canada thistle	1 ½-2 quarts
Cane (wild)	Resistant
Carpet weed	½-1 quart
Carrot (wild)	1-1 ½ quarts
Catchfly	Resistant
Catnip	¾-1 quart
Cheat—chess	Resistant
Chickory (blue flowering)	¾-1 quart
Chickweed (common)	1 quart
Chickweed (mouse ear)	1-1 ½ quarts
Cinquefoil	½-1 quart
Climbing milkweed	Resistant
Cockle (white or corn)	Resistant
Cocklebur	½-¾ quart
Corn spurry	Resistant
Crabgrass	Resistant
Cup plant—square stem	¾-1 quart
Dandelion	¾-1 quart
Dodder	Resistant or 1 ½-2 quarts
Docks (curled and yellow)	1-1 ½ quarts
Dogbane—red stem milkweed	Resistant
Dog fennel—mayweed	1-1 ½ quarts
Downy or bromegrass—wild oats	Resistant
Dragonhead	¾-1 quart
Evening primrose	¾-1 quart
False flax	½-¾ quart
Fanweed—pennycress	½-¾ quart
Flower-of-an-hour	¾-1 quart
Foxtail (giant, yellow and green)	Resistant
Goatsbeard	1-1 ½ quarts
Goatweed	1-2 quarts
Golden rod	1-1 ½ quarts
Goosegrass	Resistant
Ground cherry	Resistant
Ground ivy—creeping Charlie	¾-1 quart
Hemp—marijuana	¾-1 quart
Hemp—nettle	¾-1 quart
Henbit	¾-1 quart
Hoary cress	1 ½-2 quarts
Horse nettle—bull nettle	Resistant
Iron weed	1-2 quarts
Jimson weed	¾-1 ½ quarts
Joe-Pye weed	1-2 quarts
Johnsongrass	Resistant
Knotweed—doormat	1-1 ½ quarts
Lettuce (wild)	¾-1 quart
Lambsquarter	¾-1 quart
Mallow—butter print	1-1 ½ quarts
Marestail—horseweed	1-1 ½ quarts
Medic (black)	¾-1 quart
Milkweed (common)	Resistant
Millet (wild)	Resistant
Morning glory (annual)	½-¾ quart
Morning glory (perennial)	1-1 ½ quarts
Motherwort	1-1 ½ quarts
Mullein	1 ½-2 quarts
Mustards	½-¾ qts. or at most ½-1
Nettle (stinging or fire)	½-1 quart
Nightshade	Resistant
Nimblewill	Resistant
Nutgrass	Resistant
Oxeye daisy	1 ½-2 quarts
Peppergrass (annual)	1-1 ½ quarts
Perennial sow thistle	1 ½-2 quarts
Pigweeds	½-1 quart
Plantain (common)	¾-1 quart
Poison Hemlock	¾-1 quart
Pokeberry—pokeweed	¾-1 quart
Prickley pear cactus	Resistant
Purslane	1-1 ½ quart
Quackgrass	Resistant
Ragweed (common)	½-¾ quart
Ragweed (giant)—horseweed	½-¾ quart
Sandbur	Resistant
Shepherd's purse	¾-1 quart
Sloughgrass—watergrass	Resistant
Smart weed (annual)	¾-1 quart

Weeds	Amount of 2,4-D per acre
Smart weed (perennial)	Resistant
Snakeroot (white)	1 ½-2 quarts
Sorrels	Resistant
Spanish needles	½-1 quart
Speedwells	¾-1 quart
Spiny cida	1-1 ½ quarts
Spurge	Resistant
Squirrel-tail grass	Resistant
Stick tight	1-1 ½ quarts
Strawberry (wild)	Resistant
St. Johns wort—klamath weed	Resistant
Sunflower (wild)	¾-1 quart
Teasel	1 ½-? quarts
Thoroughwort	1 ½-2 quarts
Vervain	1-1 ½ quarts
Vetch (wild)	¾-1 quart
Violets (wild)	Resistant
Water hemlock	1-1 ½ quarts
Water hemp	½-1 quart
Wild cucumber	Resistant
Wild garlic	2-3 quarts
Wild oats	Resistant
Wild onion	2-3 quarts
Wild parsnip	1-1 ½ quarts
Wild sweet potato	1-1 ½ quarts
White top	¾-1 quart
Yarrow	1 ½-2 quarts

Water and chemical should be measured to assure that the proper dosage of 2,4-D is applied. This is particularly important when spraying in growing crops.

Dilute 2,4-D with Water

The spray solution is made by diluting the 2,4-D preparation with water. The amount of 2,4-D to add to a given amount of water will depend upon the dosage of 2,4-D and the amount of solution to be applied per acre. Sufficient water must be used to cause adequate coverage of weed growth. An application of 10 gallons per acre is usually sufficient to moisten all vegetation. More spray solution will be needed when spraying dense and heavy vegetation.

When 10 gallons of water are used per acre and the amount of 2,4-D required is one quart, add one quart of 2,4-D to 10 gallons of water. If two quarts of 2,4-D are desired per acre, add two quarts of material to 10 gallons of water. The 10 gallons of solution will cover one acre in either case.

The following table gives the amount of 2,4-D to add to 10, 20 and 50 gallons of water when applying, ½, ¾, 1, 1½, and 2 quarts of 2,4-D in 10 gallons of spray solution per acre.

Dosage of 2,4-D per acre	Amount of 2,4-D to add to water to make: 10 gals.	20 gals.	50 gals.
1 pt.	1 pt.	2 pts.	5 pts.
1½ pts.	1½ pts.	3 pts.	7½ pts.
2 pts.	2 pts.	4 pts.	10 pts.
3 pts.	3 pts.	6 pts.	15 pts.
4 pts.	4 pts.	8 pts.	20 pts.

When spraying patches of weeds with a hand or small power sprayer, it is difficult to calculate the size of the area on an acre basis. In that case, the most practical solution to use is one made with ½ pint of 2,4-D in 5 gallons of water or 1 quart in 20 gallons of water. The spray should be applied in sufficient quantity to moisten all foliage slightly. Plants should not be saturated to the point of run-off.

SPRAYING IN CROPS

When using 2,4-D to control weeds in crops, two things should be considered: (1) *How much 2,4-D will be necessary to control the weeds,* and (2) *how much 2,4-D will the crop tolerate without injury.* Generally, the dosage should not exceed the amount that the crop will tolerate even though such a dosage will give only a partial kill or merely retard the growth of the weeds. On the other hand, when patches of weeds which are difficult to kill are found in growing crops, it may be most practical to disregard the crop and apply the dosage that will produce the best kill of the weed.

Spraying in Corn

The use of 2,4-D in corn is recommended where susceptible weeds cannot be adequately controlled by cultivation. It may be used either as a pre-emergence or post-emergence treatment.

Applying the chemical to the soil before the corn emerges is called a pre-emergence treatment. The spray is applied to the soil either at planting time or shortly thereafter but before the corn comes up. Ester formulations of 2,4-D have proved the most satisfactory for pre-emergence purposes. The rate on mineral soils is 1½ quarts, and on muck, 3 quarts per acre in at least 10 gallons of water. Unfortunately, weather conditions, soil type and other factors affecting growing conditions make results of pre-emergence treatments somewhat unpredictable. Under favorable conditions such treatments will destroy some grass seedlings as well as broad-leaved weeds.

Pre-emergence applications of 2,4-D destroys many weeds as they emerge, without injury to the corn. The area on the left was sprayed; the area on the right was not.

Post-emergence treatments are applied after the corn has emerged. Rates of ½ to 1 pint of 2,4-D in 10 gallons of water per acre are recommended. Either the amine or low volatile ester may be used. Care must be taken not to overdose, as corn may be injured by 2,4-D. Injury is exhibited by

Overdosage of 2,4-D causes lodging and brittleness of corn which may result in breakage. Brittleness may remain for four or five days after spraying.

lodging and brittleness of corn. Corn is most susceptible to injury during periods of high temperature and when moisture is adequate for rapid plant growth. Sprayers equipped with drops are recommended for use when spraying large corn (12 inches or taller). When properly adjusted they will protect the corn plants from an overdose of 2,4-D.

Corn will tolerate a dosage of 2,4-D sufficient to kill many corn field weeds. When weeds are serious, spraying might save a corn crop.

Spraying in Small Grains

Weeds can be destroyed in growing wheat, oats, barley, rye and sorghums by timely spraying with 2,4-D. When grains are used as a nurse crop for clover or alfalfa, spraying might not be possible without injury to the legume. Small grains will tolerate ½ to ¾ quart of 2,4-D per acre if applied after tillering—6 inches in height—and before the heads form in the boot.

In the case of infestations of Canada thistle, bindweed or similar weeds requiring heavy dosages, some damage to the crop can be expected if the application of 2,4-D is made sufficiently heavy to obtain the best possible kill of the weed. In most cases, it will be most practical to apply only the amount the crop will tolerate without substantial injury. Respraying should be done in succeeding years to complete the eradication.

Spraying in Turfs

Dandelions, common plantain, buckhorn and several other broad-leaved weeds common in lawns, parks, playgrounds and golf courses can be killed by spraying with 2,4-D. The dosage required to kill these weeds will not harm bluegrass. New seedlings should not be sprayed however. It will injure white

clover, causing a reduced stand. For large areas, one quart per acre in 10 gallons of water is recommended. When lawns or other small areas are sprayed, use ½ pint in 12 gallons of water. This makes sufficient spray to cover an average lawn of 8,000 to 10,000 square feet. When bent grass turfs are sprayed with 2,4-D, the dosage should be reduced to ¼ the amount recommended for bluegrass because bent grasses are often injured. *CAUTION:* Care should be taken not to allow the spray to drift onto susceptible crops or ornamental plants.

Susceptible weeds may be sprayed in pastures. However, spraying may be injurious to legumes growing with the grass crop. A rate of one quart per acre is suggested for most common weeds in pastures. Although 2,4-D is not poisonous to livestock, dairy cattle should not be allowed to graze on recently sprayed areas as the odor of the 2,4-D can be absorbed by their milk.

Spraying Fence Rows and Ditch Banks

Spraying with 2,4-D is a practical way of destroying many broad-leaved weeds in fence rows, in waste places and along ditch banks. Since it is difficult to determine the amount of material to apply in terms of 2,4-D per acre, a solution made with 1 quart of 2,4-D, either amine or ester type, in 20 gallons of water is suggested. It should be applied so as to moisten all vegetation. Although 2,4-D will kill some woody plants, when woody plants such as wild grape, poison ivy, willows and wild cherry are to be destroyed, a mixture of equal parts of 2,4-D and 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) should be used in place of straight 2,4-D. The exception to the rule is corral berry or buck brush when 2,4-D is preferred to the 2,4,5-T.

CAUTION: Spray draft can damage such susceptible crops as soybeans, tomatoes, clover and alfalfa growing in nearby fields.

Spraying Canada Thistle

Canada thistle is difficult to eradicate with 2,4-D. About two quarts of 2,4-D per acre applied just before or in the bud stage of growth have given best results. When spraying dense patches, 20 gallons of spray per acre should be used. One spraying will not produce a complete kill. It will destroy the tops and prevent resprouting for about 60 days, after which new sprouts will appear from root stalks.

A 50 to 70-percent reduction in stand of Canada thistle should be considered a good kill with the first spraying. Respraying in the fall will further reduce the stand, but it is doubtful if two sprayings will complete the kill. Respraying over a period of two or more years might be necessary to finish the job. The 2,4-D treatment should not be considered a sure kill for Canada thistle but rather a means of subduing and eventually eradicating the weed.

Weeds propagating by underground rootstocks such as Canada thistle are difficult to kill with 2,4-D. The tops can be destroyed, but new shoots arise from the roots.

Spraying Field Bindweed

Best results have been obtained when spraying in the bud or early blossom stage of growth. About 1½ quarts of 2,4-D per acre is required to kill the tops and reduce the stand.

Resprouting may occur some 60 to 90 days after spraying. Respraying the following year has, in several instances, completely eradicated field bindweed. Similar results have been obtained in spraying perennial morning glory.

Spraying Wild Garlic

Results with 2,4-D for the control of wild onion and wild garlic have been erratic. Reasonably good results can be obtained when sprays are applied either during October and November or during February, March, and April. Spring applications have given slightly better results than fall treatments. The ester type of 2,4-D is preferred and should be applied at the rate of three quarts in 10 gallons of water per acre. Respraying for two or three years is necessary to obtain control of the weed, because new crops of wild garlic are produced from bulbs in the soil.

When spraying to check the growth of wild garlic or wild onion in wheat, 1½ pints of 2,4-D in 10 gallons of water is recommended. This amount will not destroy the entire plant but will aid in preventing aerial bulb formation, and should not damage the wheat materially if applied after the wheat is tillered and before the boot stage of growth.

Spraying Aquatic Weeds

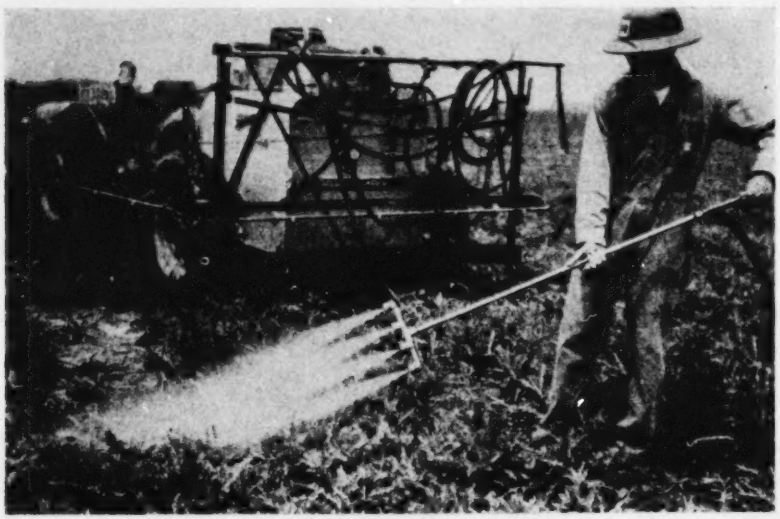
Shoreline vegetation and weeds growing above the water other than cattails, grasses, and duckweed can be controlled or at least checked in growth by spraying with 2,4-D. A solution of 2,4-D made with one quart in 20 gallons of water is recommended. All exposed leaf surfaces should be wet by the spray. Best results are obtained in early summer when plants are still growing.

CAUTION

Many crop and ornamental plants are easily injured by drifting spray of 2,4-D or from fumes that occur when volatile 2,4-D esters are used. To keep spray drift to a minimum use only low pressure application (30 psi), and do not spray when wind is blowing. Avoid spraying near valuable crops that are sensitive to 2,4-D. Some of the plants easily injured by 2,4-D are: grapes, tomatoes, tobacco, vine crops, most garden vegetables,, alfalfa, clovers, soybeans and many species of trees, shrubs and flowers.

Sprayers

Most field sprayers used to apply 2,4-D are of the tractor mounted or trailer types. The power take-off of the tractor is used to run the pump. They are low pressure sprayers usually operated at 30 to 40 pounds pressure per square inch. The output per acre of the sprayer is determined by the pressure used, the speed of travel, and the size of the opening in the nozzle. Most manufacturers recommend a speed of four miles per hour. The amount of spray applied per acre is determined by the nozzle size. Nozzles are available that will apply from 5 to 100 gallons per acre at a speed of four miles per hour and 30 pounds of pressure. When spraying small patches of



A hand boom is best suited for spraying patches of weeds. The boom attached to the rear of the sprayer is used for more extensive areas or when entire fields are sprayed.

weeds, fence rows, or ditch banks, a hand-boom or gun may be used. Small hand sprayers of the compressed air type are suitable for spraying small quantities of 2,4-D or to control weeds in lawns.

Caution: Sprayers used to apply 2,4-D should be thoroughly cleaned before they are used to apply other plant sprays. A solution of ammonia (1 pt. of household ammonia per 10 gallons of hot water) may be used to wash out tanks, pumps, and nozzles.

FOR BEST RESULTS WITH 2,4-D

- ***Study the weed problem to determine the kind of weeds to be killed.***
- ***Spray applications should be timely. Weeds are most easily killed when young and tender.***
- ***Consider the tolerance of the crop before spraying. Overdosage may result in injury.***
- ***Calculate output of the sprayer in gallons per acre at a practical driving speed.***
- ***Measure the water and measure the chemical carefully.***
- ***Respray the weeds that are only partially killed by the first application.***
- ***Do not apply 2,4-D near sensitive crops, shrubs or ornamentals. Avoid spraying during high winds to avoid spray drift. Use low volatile esters.***

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